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National Institutes of Health

1970 annual report



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U.S. National Institutes of Health
1970
annual report

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
National Institutes of Health
Bethesda, Md. 20014

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PREFACE

The National Institutes of Health, principal agency of the Federal government responsible for biomedical research, communication of biomedical knowledge, and education for the health professions, reports yearly to the public on its activities. This account always forms a part of a larger document, the Annual Report of the Department of Health, Education, and Welfare.

To permit full dissemination of information on its responsibilities and accomplishments to those with particular interest in NIH, the 1970 Annual Report is reprinted separately in this volume. Appropriate tables are appended to show appropriations, grants and other extramural awards, and personnel levels.

It is hoped this publication will serve as a ready reference source for those concerned with NIH activities.

A handwritten signature in dark ink, reading "Robert Q. Marston, M.D.", with a stylized, cursive script.

Robert Q. Marston, M.D.
Director



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NATIONAL INSTITUTES OF HEALTH

Officers

as of

July 1, 1970

| | |
|---------------------------------------|--|
| Robert Q. Marston, M.D. | Director, National Institutes of Health |
| John F. Sherman, Ph. D. | Deputy Director, National Institutes of Health |
| Robert W. Berliner, M.D. | Deputy Director for Science |
| Ronald W. Lamont-Havers, M.D. | Associate Director for Extramural Research and Training |
| Robert W. Berliner, M.D. | Associate Director for Direct Research |
| Leon Jacobs, Ph. D. | Assistant Director for Collaborative Research |
| Thomas J. Kennedy, Jr. M.D. | Associate Director for Program Planning and Evaluation |
| Thomas C. Chalmers, M.D. | Associate Director for Clinical Care |
| Leonard D. Fenninger, M.D. | Associate Director for Health Manpower |
| Richard L. Seggel | Associate Director for Administration |
| Storm Whaley | Associate Director for Communications |
| Irving Goldberg | Director of Information |
| Carl G. Baker, M.D. | Director, National Cancer Institute |
| Carl Kupfer, M.D. | Director, National Eye Institute |
| Theodore Cooper, M.D. | Director, National Heart and Lung Institute |
| Dorland J. Davis, M.D. | Director, National Institute of Allergy and Infectious Diseases |
| G. Donald Whedon, M.D. | Director, National Institute of Arthritis and Metabolic Diseases |
| Gerald D. LaVeck, M.D. | Director, National Institute of Child Health and Human Development |
| Seymour J. Kreshover, D.D.S. | Director, National Institute of Dental Research |
| Paul Kotin, M.D. | Director, National Institute of Environmental Health Sciences |
| DeWitt Stetten, Jr., M.D. | Director, National Institute of General Medical Sciences |
| Edward F. MacNichol, Jr., Ph. D. | Director, National Institute of Neurological Diseases and Stroke |
| Thomas C. Chalmers, M.D. | Director, Clinical Center |

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|----------------------------------|---|
| Roderick Murray, M.D. | Director, Division of Biologics Standards |
| Arnold W. Pratt, M.D. | Director, Division of Computer Research and Technology |
| Stephen P. Hatchett, Ph. D. | Director, Division of Research Grants |
| William B. DeWitt, Ph. D. | Director, Division of Research Services |
| Milo D. Leavitt, Jr., M.D. | Director, Fogarty International Center for Advanced Study in the Health Sciences |
| Kenneth M. Endicott, M.D. | Director, Bureau of Health Professions Education and Manpower Training |
| Vacant | Deputy Director |
| Charles H. Boettner, M.D. | Associate Director |
| Robert M. Bucher, M.D. | Deputy Director for Institutional Development |
| Eugene A. Confrey, Ph. D. | Associate Director for Program Planning and Evaluation |
| Thomas D. Hatch | Acting Director, Division of Allied Health Manpower |
| Harry Bruce, Jr., D.D.S. | Director, Division of Educational and Research Facilities |
| John C. Greene, D.M.D. | Director, Division of Dental Health |
| Jessie M. Scott | Director, Division of Nursing |
| Frank W. McKee, M.D. | Director, Division of Physician Manpower |
| Thomas G. Bowery, Ph. D. | Director, Division of Research Resources |
| Martin M. Cummings, M.D. | Director, National Library of Medicine |
| G. Burroughs Mider, M.D. | Deputy Director |
| Ruth M. Davis, Ph. D. | Associate Director for Research and Development and Director of Lister Hill National Center for Biomedical Communications |
| Henry M. Kissman, Ph. D. | Acting Associate Director for Specialized Information Services |
| Leroy L. Langley, Ph. D. | Associate Director for Extramural Programs |
| Joseph Leiter, Ph. D. | Associate Director for Library Operations |
| Jerome K. Barnett | Acting Associate Director for Audiovisual Telecommunications and Acting Director of National Medical Audiovisual Center |

The National Institutes of Health

The Year in Review

The National Institutes of Health during Fiscal Year 1970 maintained strong, productive programs for increasing knowledge on which improved national health can be based, for educating personnel to apply that knowledge in care of patients and for disseminating the new knowledge broadly and rapidly to those who can make best use of it.

The year brought specific accomplishments on a number of fronts, despite a climate of austerity related to the overall Federal financial stringency and the loss of several senior staff administrators.

Some reordering of priorities was required because of a national commitment to combat inflation and other changed conditions. Support of several general clinical research centers was phased down and it was necessary to renegotiate some research grants and make other adjustments because of budgetary limitations. The provision of predoctoral research fellowships was phased out based on a decision that these fellowships were a low order priority, considering the limitations on funds and the existence of training grants.

To fill gaps left by attrition in the ranks of senior administrators, and to provide more effective application of management skills, several additions were made to the director's immediate staff. Dr. Leonard D. Fenninger, formerly Director of the Bureau of Health Professions Education and Manpower Training, was appointed Associate Director for Health Manpower and Dr. Kenneth M. Endicott, Director of the National Cancer Institute, was appointed Director of the Bureau; Dr. Carl G. Baker was appointed Director of the Cancer Institute. Dr. Thomas C. Chalmers was named Associate Director for Clinical Care and Director of the Clinical Center, succeeding the late Dr. Jack Masur, and Mr. Storm Whaley, vice president of the University of Arkansas and Director of its Medical Center, was appointed to the new position of Associate Director for

Communications, with the assignment of strengthening scientific and technical information programs and advising the Director on communications aspects of policy matters.

In another administrative change, the National Medical Audiovisual Center was reorganized to concentrate effort on distribution of audiovisual materials.

Activity continued and intensified under the Equal Employment Opportunity Program. Two conferences were held, with Dr. Marston and his principal staff conferring with minority groups on ways to improve minority representation in all branches and levels of employment. Surveillance of employment practice to achieve improvement was continued, and other concrete programs were instituted to improve distribution of minority assignments.

Recognition for contributions of NIH staff to substantive areas came from several sources. Dr. Robert J. Huebner, Chief of the Viral Carcinogenesis Branch of the National Cancer Institute, was awarded the National Medal of Science by President Nixon in ceremonies at the White House. Mr. Richard L. Seggel, Associate Director for Administration, and Dr. Earl Stadtman of the National Heart and Lung Institute, received Distinguished Service Awards of DHEW for contributions over several past years. Dr. Stadtman, Chief of the Laboratory of Biochemistry, NHLI, also was honored with the National Academy of Sciences Microbiology Award in recognition of "outstanding contributions in the field of microbial biochemistry." Another national recognition came to Dr. James R. Slagle, Chief of the Heuristics Laboratory, Division of Computer Research and Technology, who was named one of the Ten Outstanding Young Men for 1969 by the Junior Chamber of Commerce of the United States.

The Nobel Prize was awarded to three scientists who have received support from NIH for many years, Dr. Max Delbruck of California Institute of Technology, Dr. Alfred Day Hershey of the Carnegie Institution of Washington, and Dr. Salvador E. Luria of the Massachusetts Institute of Technology. They brought to 44 the number of American Nobel Laureates employed or supported by NIH.

Secretary Robert H. Finch visited the NIH campus on November 18, 1969 to dedicate two new research buildings, Buildings 36 and 37. In his address he reaffirmed the need to maintain the overall momentum of biomedical research, but emphasized that improvement in health-care delivery systems required that "hard, even agonizing choices" be made in times of budget stringency and limited resources.

Advances toward solving national health problems were made on a number of fronts.

In basic research, an NIH grantee at the University of Wisconsin, Dr. H. Gobind Khorana, 1968 Nobel Laureate, announced the first complete laboratory synthesis of a gene, the unit of heredity. NIH scientists discovered an antigen probably causative in one type of hepatitis; the finding is leading to new tests to eliminate this danger from blood and blood products used in other human beings. Scientists at NIH and the University of California discovered the specific defect (a missing enzyme) causing Tay-Sachs disease, the most common of a group of inherited disorders producing mental retardation and early death.

The complete chemical structure of a human gamma globulin molecule, part of the body's defense mechanism against foreign substances, was elucidated by an NIH grantee at Rockefeller University, and synthesis of the first hormone from the mid-brain hypothalamus was achieved by NIH grantees at Tulane University and Baylor College of Medicine.

In clinical medicine, utilization of tissue typing technics enabled NIH scientists to bring improvement in survival of leukemia patients given transfusions of blood cell components and bone marrow transplants. NIH scientists and grantees discovered an association between measles viruses and a rare brain disorder, subacute sclerosing panencephalitis (SSPE), a finding that may determine whether viruses cause other chronic, degenerative disorders of the nervous system.

Five different types of hereditary blood lipid (blood fat) disorders, each leading to arteriosclerosis, were discovered by NIH scientists, who also developed special drug and diet treatments for each. Improvement was reported by NIH scientists and grantees in 91 percent of Parkinson's disease patients from long-term treatment with the chemical substance, L-DOPA.

National Cancer Institute

Reduction of the cancer problem through prevention and curative treatment continued to receive top priority in all research and related programs conducted and supported by the National Cancer Institute. More effective medical management has extended patient survival and brought the cure rate close to 40 percent, counterbalancing a sizable annual increase in incidence and holding the death rate to a relatively stable level.

In research on cause and prevention, emphasis was given to exceptionally promising work on viruses in relation to human cancer. In treatment, where curative surgery and radiation are limited to essentially localized conditions, efforts went forward at an undiminished pace to find new drugs for systemic or disseminated cancer and improve the techniques for using them. Fundamental research in molecular biology was concentrated largely on the chemistry of life at the subcellular level.

Cause and Prevention

VIRUSES AND CANCER

In view of thorough and repeated demonstration that viruses cause many types of cancer in laboratory animals, scientists are no longer inclined to believe that man is invulnerable to such agents. Although no human cancer has yet been shown to be of viral origin, the circumstantial evidence is increasing. Preliminary findings indicate strong association between Burkitt's lymphoma, found primarily in Africa, and a herpes type virus known as the EB type virus. Similar association exists for cancers in the back part of the mouth and nasal area and the upper throat. Whether the association is causative is still to be determined. Institute scientists reported that viruses were associated with human sarcomas, or cancers of connective tissue, and that antibodies to the sarcoma antigen were found in 80 percent of healthy relatives and other close associates of the patients.

Cells from a human breast cancer maintained in tissue culture continued to produce small amounts of virus particles for many months. On the other hand, study of the 31 adenoviruses that cause respiratory and gastrointestinal diseases in man showed that none appears to have any relationship to human cancer. Some of this continuing research is predicated on the possibility of developing an immunizing vaccine against a human cancer-causing virus. To this end viruses are being produced in quantity, colonies of test animals developed, and animal and human tissue culture systems scaled up.

CHEMICALS AND CANCER

Increasing national awareness of the need to improve man's environment has given added stimulus to research to identify cancer-causing chemical compounds used in industry and agriculture, added to food, or otherwise related to human activities. National Cancer Institute scientists participated in evaluations that led the Department to take action against indiscriminate use of cyclamates in beverages and other food products. The Institute also introduced a long-term study of the effects of saccharine as an artificial sweetener.

Cancer Therapy

TREATMENT WITH DRUGS

With close to three dozen drugs now available for treating different types of cancer, the National Cancer Institute is providing detailed clinical information on these compounds to physicians. Seminars were conducted on four drugs: cytosar for acute leukemia of adults, procarbazine in a four-drug treatment of advanced Hodgkin's disease, BCNU for Hodgkin's disease and brain tumors, and 5-fluorouracil in optimum dosage for advanced cancer of the colon. One of the most promising new drugs under study is camptothecin for advanced cancer of the rectum and intestine. Continued success in treating childhood leukemia with combinations of drugs has brought to 200 the number of patients surviving five or more years; this disease formerly caused death within weeks. With 9 drugs available for treating acute leukemia, remissions can now be regularly produced in 90 percent of patients, and in specialized treatment centers 75 percent now survive two years. The Institute developed a portable laminar-flow chamber that can be installed in a hospital room and has proved effective in reducing infection of patients receiving drug treatment.

IMMUNOLOGIC DEFENSES

The Institute established a Human Histocompatibility Tissue Typing Center to ensure the availability of compatible donors for its patients who require transfusions of white blood cells or platelets or transplants of bone marrow. Institute scientists also discovered two methods of transferring tumor immunity from one experimental animal to another. One method effected the transfer from one species to another, and may eventually have application in human disease.

Molecular Biology

Continuing in a field of research in which he shared a Nobel prize in 1968, a scientist working under a National Cancer Institute grant reported the first complete synthesis of a gene, the heredity-determining subunit of deoxyribonucleic acid (DNA) that gives a cell, an organ or an organism its special characteristics. Other teams of investigators supported in part by the Institute found that in some instances ribonucleic acid (RNA) is the master chemical that controls the synthesis of DNA, which seems to reverse the previously accepted belief that DNA always controls the synthesis of RNA. The finding of a double-stranded RNA, which may be a part of the cell's normal machinery, is compatible with the "oncogene" theory advanced by an Institute scientist that all cells possess incomplete or masked viruses with potential cancer-causing activity.

Program Administration

During the fiscal year 1970 programs of the National Cancer Institute were administered at an operating level within the President's appropriation recommendation of \$180,725,000.

| | <i>FY, 1969</i> | <i>FY 1970</i> |
|----------------|-------------------------------|-------------------------------|
| Agency Funding | \$182,896,000 | \$180,634,000 |
| Employment | 1,485 (includes 74 for VA) | 1,423 (includes 68 for VA) |

The total number of grants awarded in FY 1970 was 1,535 with a funding level of \$92,846,000. The total number of contracts awarded was 324 with a funding level of \$49,940, 000.

National Eye Institute

The National Eye Institute became operational as an independent organization within the National Institutes of Health during fiscal year 1970. Autonomous status was gradually attained with the transfer of vision programs from the National Institute of Neurological Diseases and Stroke, the appointment of Dr. Karl Kupfer as the first NEI Director, and the recruitment of scientific management, grants management, and administrative personnel. The Institute received its first separate appropriation during the year, enabling the specific allocation of funds to intramural and extramural research, training activities and program direction.

Retinal Studies

Among the year's important intramural research accomplishments was the reversal of retinitis pigmentosa associated with a rare metabolic disorder, the Bassen-Kornzweig syndrome. This marked the first time a degenerative disease of the retina had been reversed, indicating the possibility of long-term or even permanent management of this and other forms of retinal degeneration.

The successful use by an NEI grantee of the argon gas laser in treating a number of vascular diseases of the eye gave promise of a new tool for treating visual disorders not responsive to other forms of therapy. The argon laser, which puts forth an intensive blue-green light, may be particularly suited to the treatment of certain eye blood vessel diseases because, unlike the red beam of the ruby laser, the beam is absorbed by the red blood pigment. The new laser is undergoing clinical trials by a number of Institute-supported investigators to determine its safety and effectiveness in treating diabetic retinopathy, now the second leading cause of new adult blindness, and other vascular conditions of the eye.

Cataract Management

Progress toward the medical management of cataract was made by preventing the formation of sugar cataracts in rabbit lenses cultured in a high-galactose medium. In studies supported by NEI, rabbit lenses maintained in the sugar medium developed opacities and swelling during the first four days of culture. When TMG, a chemical which inhibits an enzyme (aldose reductase) implicated in cataract formation, was added to the high-galactose medium, cataracts did not form during an eight-day incubation period. These findings suggest that the enzyme aldose reductase plays a primary role in the initiation of sugar cataracts in the rabbit lens.

Grant supported studies succeeded in identifying for the first time a group of cells in the visual cortex of macaque monkeys which play an important part in stereoscopic depth perception. The cells are believed to link the visual fields from each eye thereby creating the ability for three-dimensional vision. This finding will undoubtedly pave the way to greater understanding of human disorders of binocular vision, particularly those associated with strabismus.

Grants Awarded by the National Eye Institute—FY 1970

| <i>Program</i> | <i>Number</i> | <i>Amount</i> |
|---|---------------|---------------|
| Research (including clinical research centers) | 353 | \$15,173,000 |
| Training | 52 | 2,984,000 |
| Fellowships | 57 | 890,000 |

National Heart and Lung Institute

During fiscal year 1970, the National Heart Institute was renamed the National Heart and Lung Institute and assigned primary responsibility for federally supported research and training activities directed against emphysema and related chronic lung diseases, which are beginning to rival coronary heart disease as a cause of disability and whose death toll has risen alarmingly in recent years. The Institute was also reorganized to improve program planning capabilities and to increase flexibility in responding to present and foreseeable needs in the cardiovascular and lung-disease fields.

Extramural Research and Training

During the fiscal year, NHLI supported 1,643 research grants totalling \$86.6 million for studies directed toward the prevention, diagnosis, and relief of cardiopulmonary disorders. Key research areas included 1) arteriosclerotic disease (including coronary and cerebrovascular disease); 2) cardiac disease (including congenital and rheumatic heart disease, heart failure, and shock); 3) hypertension and kidney disease; 4) chronic lung disease; 5) thrombosis and hemorrhagic diseases; and 6) cardiac replacement, including transplantation and artificial-heart development. Buttressing the disease-oriented research was a broad program of basic research on the structure, function, metabolism, performance, and regulation of the cardiovascular and pulmonary systems and their components.

Collaborative Research and Development

The Medical Devices Applications Branch (formerly the Artificial Heart Branch) awarded 108 research contracts totalling more than \$9.5 million for studies bearing on the development of heart-assist devices and mechanical replacements for hearts damaged beyond salvage. The contracts covered 13 areas, including materials development and evaluation, external and internal power sources and control mechanisms, development and/or improvement of circulatory-assist devices, the physiological consequences of circulatory assistance, and development of test and evaluation facilities for new hardware and techniques.

A major advance during the year was the successful implantation in animals of a heart-support system, including blood pump, energy source, and control mechanisms, that provided reliable, long-term

circulatory assistance while permitting periods of freedom from the encumbrance of external power sources and control consoles.

The responsibilities of the Branch were expanded to encompass development and evaluation of devices for respiratory assistance or lung replacement.

The Myocardial Infarction Branch supported 16 contracts totaling \$7.1 million during FY 1970. These included continued support of 9 Myocardial Infarction Research Units (MIRU's), previously established for the intensive study of acute heart attacks and improvement of all phases of coronary care, and a series of studies on sudden death which overtakes fully half of all heart attack victims before they can reach medical assistance.

The goals of the sudden-death studies include 1) identification of factors in the individual or his environment that increase his susceptibility to rapidly lethal heart attacks; 2) identification of premonitory symptoms, if any, that might warn the patient or his physician of impending trouble, so that the physician might initiate measures to prevent the threatened heart attack or at least hospitalize the patient before onset; and 3) identification of "trigger factors" that convert an insidious, frequently asymptomatic blood vessel disease into a full-blown heart attack.

The Branch has also supported the development of a promising computer system for collection, integration, and display of clinical and physiological data recorded from heart-attack patients. This system is already operative in two MIRU's and will be installed in three others in the near future.

The National Blood Resource Program supported 47 contracts totalling \$2.87 million for research and development activities for improving technology relevant to acquisition, fractionation, preservation, and distribution of whole blood and blood components. These activities resulted in:

- A technique for extracting antihemophilic factor—which temporarily corrects the coagulation defect of classical hemophilia—from large batches of blood plasma. The technique, developed by the American Red Cross, promises in time to increase the availability and reduce the cost of AHF concentrates, which offer many advantages over conventional transfusion therapy in preventing or controlling serious bleeding episodes in hemophilic patients.
- A more effective, less cumbersome method of preserving red blood cells for prolonged periods, and perhaps indefinitely, by freezing.
- Development of several promising prototypes of a computer-

ized inventory system for whole blood, blood components, and rare blood donors that promises to minimize or eliminate many present problems of supply and demand.

- Development of several screening procedures that show promise in detecting the presence of hepatitis virus in prospective blood donors.
- Progress toward the development of a reliable testing procedure to detect hypercoagulable states that may predispose to clotting complications of cardiovascular disease, the major direct cause of heart attacks and strokes.

Intramural Research

The NHLI Intramural Research Program combines basic research on cardiovascular physiology in health and disease with clinical studies directly concerned with the development and evaluation of new or improved techniques for the prevention, diagnosis, and treatment of cardiovascular and related disorders. Among significant results were the following:

- Calcium infusions produce dramatic and frequently long-lasting improvement in patients with osteoporosis, a bone-thinning disease quite common in older people which makes them highly susceptible to fractures.
- Three initiation factors—designated M_1 , M_2 and M_3 —appear to be essential to turning on the process by which proteins are assembled from their component amino acids in mammalian cells. The concentration of these initiation factors also appears to be a determinant of the rate of protein synthesis.
- A miniaturized blood oxygenator was developed and is undergoing clinical trials to assess its effectiveness in treatment of hyaline membrane disease, a principal cause of death among premature infants. In an earlier test, the oxygenator maintained adequate blood-oxygen levels for 10 days, exceeding by 4 days the longest previous respiratory support by this means.

National Institute of Allergy and Infectious Diseases

Immunology

Of unusual significance in the field of immunology during the year was research on the relationship between disease susceptibility and an individual's "histocompatibility profile"—the array of antigens, or foreign substances, which characterize white cells and which are used to "match" tissues in transplantation.

NIAID work in this area has been particularly productive. Scientists in the Institute's Laboratory of Immunology have shown that, in certain strains of guinea pigs, one gene controls an animal's responsiveness to challenge by a specific chemical (poly-l-lysine). Breeding experiments showed this gene is inherited together with important histocompatibility antigens and that portions of the chromosome controlling both factors are very closely linked, if not identical.

Although the ultimate biological role of histocompatibility systems is still unknown, some scientists believe that resistance of the individual to infection and to cancer may be related to the composition of the genes controlling histocompatibility antigens. Indeed, investigations by an NIAID grantee have shown a remarkably high correlation between a certain antigenic profile and the prevalence of acute leukemia in children. The similarity of this finding to the well-recognized susceptibility of certain antigenically defined mice to a mouse leukemia virus can hardly be coincidental.

In the Institute's collaborative transplantation and immunology program, results of the evaluation of histocompatibility typing have demonstrated need for a multiplicity of tests in identifying the antigens involved in rejection of transplanted organs. Five new HL-A antigens were identified during the year, bringing the total to eleven officially recognized types.

To assist in studies of immunosuppression, anti-human lymphocyte sera (ALS) have been prepared by NIAID contractors in horses and rabbits. Pharmacological studies are under way in primates to define the toxicity, optimum dose, and most efficient routes of administration of these preparations.

Antiviral Efforts

New information emanating from research on interferon—a natural antiviral substance of the body—has made need apparent for

support in some directed areas. The Institute's new collaborative program on antiviral substances is focusing first, therefore, on interferon. Contracts have been awarded for studies of more efficient methods of assaying, purifying, and producing interferon. Attempts will also be made to enhance the effect of interferon inducers and to reduce their toxicity.

Using the interferon inducer poly I:C, Institute investigators carried out a number of important studies, with emphasis on factors pertinent to clinical application.

The effectiveness of poly I:C in controlling respiratory infections has been explored in tissue culture, laboratory animals, and human volunteers. The drug showed a wide spectrum of activity against respiratory viruses *in vitro*, and against intranasal influenza in mice. Partial activity was demonstrated when poly I:C was given topically to volunteers who had been inoculated with influenza or common cold viruses.

There has been considerable progress in understanding the epidemiology of serum hepatitis as related to the Australia antigen—also known as hepatitis-associated antigen (HAA). Although it is not yet known whether HAA is a virus or merely an antigen associated with the causative agent of the disease, methods for measuring HAA and detecting antibody could provide a means for identification of blood donors who might be infective. In a collaborative study with the NIH Blood Bank, Institute scientists, using improved serological techniques which they helped develop, established a definite correlation between transfusion of HAA in blood and resultant hepatitis in the recipient.

In an effort to facilitate fast-moving research in this field, NIAID's Research Resources Branch is now making available characterized reference materials for both the Australia antigen and specific antiserum.

The 1968 outbreak of Hong Kong influenza afforded an unparalleled opportunity to test the effectiveness of purified inactivated influenza vaccines.

In a study in Michigan, it was demonstrated that mass immunization of school children reduced the incidence of influenza in the whole community.

Bacteriology

Cases of streptococcal sore throat and scarlet fever in the United States appear to be increasing; there were 426,271 in 1969. There is cause for concern as more and more strains of streptococci and other bacteria are found to be resistant to many different antibiot-

ics. An Institute grantee who in 1968 announced the synthesis of the antibiotic oxytetracycline put together two additional broad-spectrum antibiotics during the past year. All three drugs are effective against organisms causing such diseases as pneumonia, syphilis, meningitis, typhus, and scarlet fever. The methods used to synthesize these compounds show promise for developing a new family of totally artificial drugs tailored to combat specific infections.

Parasitology

Domestic cats have been incriminated as a "missing link" in spread of the toxoplasmosis organism, which may cause serious congenital malformations in man. In three independent reports by NIAID scientists and grantees, evidence has been presented that *Toxoplasma gondii* can complete its life cycle in the cat. The specific role cats play in transmission of toxoplasmosis is as yet unknown.

National Institute of Arthritis and Metabolic Diseases

Advances by the Institute against numerous disorders ranged from the laboratory synthesis of a new hormone ("thyrotropin-releasing factor"), important in regulating the pituitary gland, to successful clinical trials of a new generation of improved artificial kidneys.

Arthritis and Bone Disorders

Research continued to implicate viruses or a disorder of the immune system or a combination of both as causes of rheumatoid arthritis. Basic studies by the Institute led to the demonstration of an active, transmissible factor in human rheumatoid arthritis tissue. Investigators injected extracts of these tissues into female mice, which acquired a rheumatoid arthritis-like disorder, passed it on to their offspring, and these, in turn, transmitted the disease to succeeding generations.

Diabetes

Diabetes remains a little-understood but grave disorder. Understanding the role of insulin both in health and in diabetes seems central to the problem. Recently, scientists found evidence that this hormone influences cell metabolism by interactions with outer regions of cell membranes without ever entering the cell proper.

A 10-year, multi-clinic, Institute-supported study of the effects of oral anti-diabetic drugs, conducted by 12 leading medical centers, has demonstrated that tolbutamide (Orinase) is no more effective than diet alone in the treatment of mild, adult-onset diabetes mellitus except insofar as it lowers blood glucose. It is less effective than diet or diet and insulin in reducing mortality from heart disease and related conditions in such patients. Tolbutamide is widely used in diabetes therapy.

Epidemiological Research

Diabetes and gallbladder disease have been found by Institute scientists to be many times more prevalent in the Pima Indians of Arizona than in the general United States population. During the past year, these investigators of the Southwestern Field Studies Section, continuing their epidemiological research among the Pimas, reported that in elderly persons high blood sugar levels are chiefly a clue to diabetes, rather than to a "normal", age-associated deterioration of glucose tolerance, as had been believed. In another

diagnostic advance, the scientists showed in this population that the relationship of swollen parotid glands to diabetes, believed for nearly 40 years to be a direct one, results rather from a common association of both the swollen glands and diabetes to obesity.

Cystic Fibrosis and Other Metabolic Diseases

Several studies provided additional clues to the cause of cystic fibrosis, a serious disease of children. The characteristic disorder of sweat excretion was traced to abnormal function of the excretory ducts of the sweat glands. Also, the skin of cystic fibrosis patients was found deficient in beta glucuronidase, an enzyme linked to mucopolysaccharide metabolism.

Numerous advances were reported in the understanding, diagnosis, and treatment of several other metabolic diseases, including for example, hypothyroidism, cystinosis, goiter, acromegaly, and others.

Endocrinology

Institute grantees have synthesized a readily reproducible, biologically active hypothalamic hormone, thyrotropin-releasing hormone (TRH). TRH stimulates the pituitary gland to release thyroid-stimulating hormone (TSH), which in turn stimulates the production of thyroid hormones. An important aspect of this advance is the possibility that successful synthesis of *other* hypothalamic hormones (which are known to exist) could provide new departures for regulation of basic body functions controlled by the pituitary gland, including sterility and fertility.

Kidney Diseases and the Artificial Kidney

New and improved prototypes of artificial kidneys are undergoing clinical trials as a result of the Institute's centrally directed program of research and development. Among these is a presterilized "envelope artificial kidney" that is easier to use in home dialysis. In transplantation research, tissue matching of *both* leukocytes and kidney cells was found to improve markedly the survival rate of transplanted cadaver kidneys. Progress was also reported in improved understanding of numerous kidney diseases.

Digestive Diseases and Nutrition

Gastroenterology research benefited from apparatus developed by the artificial kidney program—a long-term intravenous feeding system ("artificial gut") that can be lifesaving for patients with sub-

stantial loss of bowel function. In other studies, a diet including special man-made fats (medium-chain triglycerides) was shown to improve the nutritional status of patients in whom bowel resection has led to the "short bowel syndrome" of chronic, progressive nutritional deficiency.

During the year, investigators employed an antibody preparation that binds the functional portion of the gastrin molecule to inhibit gastric acid secretion in rats. Inhibition of excessive gastrin-mediated acid secretion might have important clinical application in the management of peptic ulcer.

Institute-sponsored studies in India showed that wheat enriched with the inexpensive amino acid lysine improves the growth of protein-deprived pre-school children. Cottonseed flour was shown in Institute-sponsored investigations in Peru to support adequately and by itself the protein needs of rapidly growing infants and children.

Diseases of the Blood

Research on hemophilia demonstrated that aspirin may prolong bleeding time and may be a hazard to patients with severe forms of the disease. The spleen was shown to synthesize sufficient quantities of antihemophilic factor to warrant further consideration of spleen transplantation for hemophilia. Institute scientists further conducted clinical trials of Factor VIII in *long term* prophylactic treatment and found that, used selectively in severely affected patients, it can reduce the number of spontaneous hemorrhages.

Two sensitive tests have been developed to aid in screening potential blood donors, and blood intended for transfusions, for presence of the serum hepatitis virus ("Australia antigen").

New Teaching Film

A new medical teaching film, "Management of Chronic Renal Insufficiency," jointly sponsored and financed by the Institute and the National Kidney Foundation, was completed.

National Institute of Child Health and Human Development

The National Institute of Child Health and Human Development conducts and supports research and training on human development from the period of conception through old age. Within this framework, during the past year the Institute placed emphasis on population research, research in early childhood development and the related areas of nutrition and mental retardation.

Total funding in 1970 was \$76,000,000, an increase of \$4,885,000 over the 1969 expenditure. The number of full-time employees in 1970 was 415, an increase of 15 over 1969.

The Institute supported about 1,319 research grants, grants for research training, and research contracts for approximately \$65.9 million. This represented a decrease of 9 percent in numbers of projects (124) and an increase of 7.6 percent in funds (\$4.67 million) from fiscal year 1969.

Population Research

Each child who comes into the world is at once a potential contributor to the world's resources and a consumer of these resources. The population of the world will double by the end of this century. At the rate population is increasing, limitation of family size is considered imperative. Through grants and contracts, the Center for Population Research, established in August, 1968, supports research and research training in these areas: development of new contraceptives, medical effects of existing methods of fertility control, and social and behavioral aspects of population change. All told, the Institute spent approximately \$16.4 million in 1970 in population research.

Investigators at the Institute have been searching for a simple way to detect ovulation, thus making the rhythm method a more successful means of family planning. Following development of a laboratory technique which accurately predicts ovulation in rhesus monkeys within two days, research is progressing on the application of this technique to humans.

The medical effects of oral contraceptives have been the subject of particular attention; several studies have indicated that women who use oral contraceptives may have an increased tendency to develop clotting disorders. Other studies supported by the Institute documented changes in sugar and fat metabolism in women taking "the pill." Investigations are underway to determine if there is a

link between use of oral contraceptives and subsequent development of strokes and cancer of the cervix, uterus, and breast.

Research on the Developing Years

Nutrition—The Institute has been supporting both animal experiments concerning the effects of malnutrition on critical developmental stages and studies of human populations suffering from severe malnutrition. Principal attention is being given to the latter. The most carefully designed of these studies aimed at analytically separating social factors from nutritional factors affecting intellectual development, is continuing in Guatemala.

Research of the effects of severe malnutrition in other countries is augmented by projects centering in ghetto populations in the United States. Taken together, the investigations will permit determination of the impact of early malnutrition on intellectual development and assess its consequences for children.

In 1970, the Institute spent \$6,500,000 for nutrition research and related activities.

Growth and Learning—In the area of growth and learning, the prime issue is to reveal the optimal conditions—both genetic and environmental—for full and healthy development.

One large-scale longitudinal study is investigating how genetic, biologic, medical, and environmental factors affect the outcome of pregnancy and the subsequent development of offspring. To date, over 20,000 pregnancies have been followed, and nearly 18,700 live-born infants have entered the study.

Studies of learning in very young infants and their responses to visual stimulation may be important to the understanding of reading disabilities and reading readiness. Previous research indicates that the infant, even as a newborn, is capable of learning and is responsive to stimulation. The possibility that training of infants and very young children with visual and auditory stimulation can help develop reading ability is now being investigated.

In 1970, the Institute spent \$13,200,000 to acquire new knowledge on growth and learning.

Mental Retardation—A beginning toward solving many of the problems of mental retardation has been made by the Institute through establishment and support of 12 Mental Retardation Research Centers, eleven of which will be operational by the end of next year.

At the research center at Parsons, Kansas, a joint effort of psychologists and audiologists has developed a conditioning technique to measure hearing in the very young or in retarded children un-

able to cooperate with the audiologist. Research conducted at the University of Colorado Center demonstrated that intellectual capacity was substantially reduced in indigent Spanish-American children hospitalized for malnutrition during infancy.

In 1970, obligations for all the Institute's mental retardation activities were \$9.2 million, up 5.7 percent from the previous year.



National Institute of Dental Research

Dental Caries

Preliminary tests show that treatment with a plastic sealant has prevented for over a year the most common form of tooth decay, which begins in small pits and grooves on the biting surfaces of children's teeth. This colorless adhesive is quick, safe, painless, and easy to paint on the chewing surfaces of clean, slightly etched teeth. It is hardened by a specific type of long-wave ultraviolet light.

Animal studies are clarifying some host-bacteria-diet relationships in caries. Bacterial strains responsible for decay in pits and grooves usually differ from those that cause trouble on smooth surfaces, and from those that destroy root surfaces beneath the gums. Destructive organisms also differ in their uses of various elements in the human diet. Table sugar (sucrose) is chiefly involved in their production of decalcifying acid.

Certain streptococci that are able to form a glue-like plaque have been found to decay smooth surfaces of the teeth. Recently, a type of lactobacillus has likewise proved to be a highly acid, sugar-dependent, plaque former. Since this organism also grows in pockets at the base of human teeth, it may contribute to periodontal (gum) disease as well.

Restorations

Until caries can be prevented, more effective, durable, and easily applied restorative materials will be needed. An improved dental cement has tested well as a fastener of crowns and bridges, and as a base for deep fillings. It is now in commercial production.

A test has been developed to determine how amalgams will perform as clinical fillings, and in preliminary studies a new gallium-palladium-tin alloy shows improvements over ordinary amalgams. A fiber-reinforced, gold-nickel alloy also promises to be useful for orthodontic and denture purposes.

A potential filling material, not yet tested clinically, combines hard, X-ray-opaque, glass particles with durable plastics and adhesives. It may be a useful and aesthetic substitute for tooth structure. Also under experimental study, plastic and ceramic implant substitutes for teeth appear promising.

To increase acceptability of tooth transplants, mature teeth have been pre-treated with enzymes and fluoride. In a related effort to persuade the body to accept more foreign proteins, monkeys have been made tolerant to certain soluble proteins.

Periodontal Disease

Research is demonstrating that immune reactions to particular microbes, and abnormal levels of certain enzymes and hormones in gum tissues play a role in periodontal disease. For example, hormone therapy has controlled one refractory form of gum disease in women with abnormal ovarian cycles. Also, more of the collagenase enzyme, which destroys the chief molecule in connective tissue, has been found in arthritic joints and diseased gums than in normal tissues.

Cleft Palate

This year the Institute prepared for professional use a *Directory of U.S. Facilities Providing Cleft Lip and Cleft Palate Services*. As an aid in developing control of the palate in speech, a new instrument was devised to measure directly and record the motions of the soft palate without interfering with its functioning.

National Institute of Environmental Health Sciences

The Institute took important strides in 1970 in contributing to the growing Federal responsibility for environmental quality.

A report on Research Planning in Environmental Health Science was prepared at the request of the Environmental Health Sciences Advisory Committee. The report addresses itself to the full array of environmental health problems and the potentials for their solution. The first direct result of this report was a conference sponsored by NIEHS to review the feasibility of monitoring human populations for evidence of mutagenesis.

Institute scientists presented research data and analyses on DDT and other persistent pesticides to the "Secretary's Commission on Pesticides and Their Relationships to Environmental Health" (Mrak Commission) prior to imposition of Federal restrictions on DDT use.

Industrial Products

Consultations with Congressional committees, the Federal Water Quality Administration, and the baby foods and detergents industries added new dimensions to Institute programs. Short-term studies were conducted on the presence of nitrites and nitrates in water supplies and baby foods, on the potential health effects of optical brighteners and enzymes in home laundry detergents, and on the precise health effects of exposure to the pesticides 2,4,5-T and 2,4-D. NIEHS also reviewed several documents, prepared by the National Air Pollution Control Administration, designed to aid in setting air quality standards.

Research has focused on fundamental problems in environmental health sciences. Significant contributions were made in studies of hazards in ionizing and non-ionizing radiation, pesticide synergists, teratogenesis and mutagenesis, and by development of the Virginia opossum as a unique model for environmental health research.

Herbicide Research

The herbicide 2,4,5-T was thoroughly evaluated by NIEHS. The Surgeon General's announcement that 2,4,5-T was a hazardous substance, the use of which should be curtailed, was based partially on NIEHS findings of its teratogenicity.

An NIEHS grantee is working to trace pathways and rates of absorption of topically applied mercuric chloride in normal human skin, to determine whether absorption differs in persons with mercury sensitivity. Localization of the metal in cutaneous cells has been observed.

Interest in the potential health hazards of fungal contamination of food, feed, and other products has focused on the mycotoxins produced by *Alternaria tenuis* and related molds, on isolation and identification of the toxins, and on toxicologic evaluations. Synergistic bactericidal activity of metabolites of *A. tenuis* has been demonstrated.

*National Institute of Environmental Health Sciences, distribution
of appropriation
(In thousands)*

| | 1969 actual | 1970 estimate |
|---------------------------------------|----------------|------------------|
| Research grants: | | |
| Regular program: | | |
| Noncompeting..... | \$3,728 | \$3,165 |
| Competing..... | 387 | 460 |
| Supplemental..... | 115 | ----- |
| New..... | 864 | 900 |
| Total, regular..... | 5,094 | 4,525 |
| Special program: | | |
| General research support..... | 551 | 528 |
| University-based centers..... | 2,993 | 2,850 |
| Total, special..... | 3,544 | 3,378 |
| Total, research grants..... | 8,638 | 7,903 |
| Fellowships..... | 194 | 164 |
| Training grants..... | 3,650 | 3,617 |
| Total, grants..... | 12,482 | 11,684 |
| Laboratory and clinical research..... | 3,628 | 4,894 |
| Research contracts..... | (653) | (1,012) |
| Review and approval..... | 294 | 367 |
| Program direction..... | 300 | 346 |
| Management fund..... | 1,201 | 277 |
| Total, direct operations..... | 5,423 | 5,884 |
| Total..... | 17,905 | 17,568 |
| Reserve..... | 112 | 755 |
| Total appropriation..... | 18,017 | 18,323 |

*National Institute of Environmental Health Sciences, research
grants program analysis*

| | 1970 estimate |
|--------------------------------------|---------------|
| Toxicology..... | \$1,925,000 |
| Pesticides..... | 1,447,000 |
| Natural products..... | 441,000 |
| Synthetic organics..... | 208,000 |
| Heavy metals..... | 186,000 |
| Smoking and Health..... | 210,000 |
| Alpha Emitters..... | 108,000 |
| Subtotal, regular program..... | 4,525,000 |
| General research support grants..... | 528,000 |
| University-based centers..... | 2,850,000 |
| Total, research grants..... | 7,903,000 |

National Institute of General Medical Sciences

Automated Clinical Laboratory Development

Effective health maintenance programs require that physicians have rapid access to accurate laboratory data at reasonable cost. This is necessary if they are to assess the health of patients in order to detect and thwart the onset of disease. To this end the Institute increased by \$1.4 million, to \$5.1 million, its support of basic and biomedical engineering research and development to automate clinical testing.

Nearly \$1 million of the increase was for grants covering inquiries to separate and identify medically significant substances in body fluids and tissues. Contract work to develop modular instrumented systems was increased \$450,000. For example, one computerized laboratory data system under development connects directly with various assay instruments and gains input from others through data consoles and machine-reading mechanisms. Test results are made available to attending physicians within minutes after completion; for review of a patient's condition and response to therapy, cumulative summaries are provided on all laboratory work performed in a single day.

Twelve of these units were built and tested in hospitals during the year. Experience to date shows the system shortens by up to a day the time patients may spend in hospitals awaiting tests results, and reduces by 40 percent the work of hospital staff in handling test information.

Trauma Research

To extend its work for better care of the injured, the Institute in May held a three-day International Trauma Symposium. Scientists from six countries revealed many deficiencies in knowledge of the total impact of injury upon body systems and in the ability of communities to provide quality emergency care. Research needed was identified in areas of wound infection and healing, and in fundamental hemodynamic, metabolic, cardiac and respiratory changes following trauma.

Although the Institute had sought to fund one or two more trauma research centers, none of the applications received was of sufficiently high merit. In the seven centers currently supported,

that the survival rate of patients is close to 80 percent despite the fact most are near death at admission.

Pharmacology

Grants for large projects in pharmacology research were awarded to Brown University (\$306,934) and New York University Medical School (\$202,190). These focus on drug effects on immune systems and on hereditary factors which influence drug metabolism. Another large study will investigate use of antifungal drugs to treat human prostate gland enlargement effectively and possibly to lessen high blood cholesterol levels.

Fellowships

Analysis of the Institute's support of postdoctoral and special fellowships revealed that a large portion of the awardees achieved academic health-related teaching and research careers—85 percent of the postdoctoral awardees and 91 percent of the special fellows. Institute fellowship support thus was shown to contribute importantly to production of medical school faculties and expansion of enrollments.

National Institute of Neurological Diseases and Stroke

In 1970 the National Institute of Neurological Diseases and Stroke celebrates its twentieth anniversary. During its history the Institute has developed extensive research programs on all principal neurological and sensory disorders. It has also made a notable contribution through training of research scientists, teachers and clinicians in neurology, neurosurgery, ophthalmology, otolaryngology, neuroradiology, and many of the basic sciences.

This past year, long-term research efforts have been paying off in several important areas. An especially good example is L-DOPA, a new drug beneficial to patients with Parkinson's disease. Much of the 10 years of work on the development of this recently FDA released drug was supported by the NINDS.

Biochemical Abnormalities

L-DOPA replenishes an enzyme, dopamine, deficient in parkinsonism patients in the particular region of the brain which affects motor control of the body. Spectacular as the results of the drug have been, even more exciting is the new look these findings give to the whole picture of biochemical abnormalities of the central nervous system and of brain cell metabolism. The new understanding which is evolving could unlock mysteries relating to many neurological disorders. One medical journal called L-DOPA the most important contribution to therapy of a neurological disease in the past 50 years.

L-DOPA had already been found beneficial for several other neurological disorders marked by movement disability, including progressive supranuclear palsy, dystonia musculorum deformans, and parkinsonism dementia.

Rare Neurological Disorders

Basic research is also providing clues to some of the rare neurological disorders. In a number of diseases, detection of inborn errors of metabolism before birth may prevent, even eventually eliminate, the tragedy of such diseases. The missing enzyme has now been identified in six of the so-called lipid storage disorders, including Tay-Sachs disease.

Detection of these conditions before birth is now possible through the process of amniocentesis.

Research is also adding knowledge about the wasting progressive neuromuscular diseases. One of the principal methods for preventing muscular dystrophy, for example, is to detect persons who carry the gene for the disease, and alert them about the possibility of their children inheriting MD. Two research studies this year have advanced ability to detect clinically normal carriers of the gene for Duchenne muscular dystrophy, the most common form of the disease. A rare genetic disease called hyperkalemic periodic paralysis can now be relieved with a drug, acetazolamide. However, it is not yet known how the drug works.

Multiple Sclerosis

Research on the crippling sclerosing disorders such as multiple sclerosis has recently provided additional evidence they may be of viral origin. A number of studies around the world point to the age of 15 as the crucial period for contracting the mysterious agent causing multiple sclerosis, although the main symptoms of the disease do not appear until years later.

A long used therapy, treatment with the compound ACTH, was proven to be of little benefit to MS patients. However, the extensive drug trials with rigid protocol used in the research may prove to have great value as a method for testing other drugs.

Collaborative Project

Recent findings in the Institute's long-term mother-child study confirm earlier results on the relationships of prenatal factors to neurological deficits of childhood. A series of investigations has shown restriction of maternal weight gain is associated with a reduction in birth weight. The studies also show that such reduced birth weight is associated with an increase in the neonatal mortality rate, and that normal weight gain in pregnancy is unrelated to acute toxemia.

The Laboratory of Perinatal Physiology, a counterpart to the Collaborative Project human study, was moved this year to the Washington area from Puerto Rico. The new location will make it possible to provide closer supervision and collaboration with other intramural laboratories, easier recruitment of qualified permanent staff members, and elimination of duplicate administrative facilities. However, the Institute will continue to provide some support and to participate in the primatology research on the offshore islands and at the experimental compound facility at Sabana Seca.

Stroke Research

In response to its increased responsibility, NINDS is placing greater emphasis on its stroke and cerebrovascular disease programs. In recent years the Institute has built 19 stroke research centers. These are each now staffed by 15 to 20 scientists and clinical investigators plus technicians and other assistants. Most have interrelated clinical and basic research programs and accommodate up to 30 research patients.

One of the greatest needs in the field of cerebrovascular disease has been reliable data to aid early diagnosis and effective treatment. Recent epidemiological studies supported by the Institute show regional variations in stroke incidence within the U.S. The death rate for stroke is higher in men than in women, the ratio being 1.3 to 1 in the 40 to 49-year age group, and 1.4 to 1 in the 70 to 79-year age group. It was also found that diabetes, high blood pressure, overweight, lack of exercise, and cigarette smoking all predispose people to strokes.

Head and Spinal Cord Injuries

Another area now receiving careful attention by the Institute is head injury and spinal cord injury. Surveys indicate that head injuries occur in 71 percent of persons hurt in auto accidents. Among the new research centers are seven concerned with head injury. Also, it is estimated that 100,000 persons in the Nation are paralyzed in either arms or legs or both due to spinal cord injury. The Institute is placing more emphasis on providing immediate assistance to spinal cord accident patients through multidisciplinary management of acute care and of early rehabilitation.

At least one in every 10 Americans (20 million) has a communication problem. This past year the status of the field of human communication—hearing, language, and speech—was reviewed by 150 distinguished researchers. These experts reported that NINDS is supporting one-third of all research in this area, and other parts of the Department another third. The need for a refinement of hearing tests for children was stressed as was research relating to nerve deafness.

NINDS recently has taken some steps into the largely unexplored area of artificial sensory aids. One of the most fascinating research concepts is the possibility of developing substitutes for vision and hearing by direct stimulation of the brain. An experimental program has been initiated to examine the feasibility of this concept.

Clinical Center

In its supporting role of providing clinical research facilities and services for the National Institutes of Health, the Clinical Center proceeded with programs to assure the optimum in patient care.

Hepatitis Control

Through intensive research, the Blood Bank staff was able to prove that incidence of post-transfusion hepatitis increased when blood from commercial donors was used. Steps therefore were taken to eliminate use of commercial blood supplies in meeting needs of Clinical Center Patients. The Australia antigen test for hepatitis was introduced in routine screening of volunteer donors.

New radioisotope and radiologic equipment, as well as refinements in television engineering techniques, permitted further sophistication in the diagnostic capability of the Nuclear Medicine and Diagnostic Radiology departments.

To provide specialized, quality patient care, the Nursing Department during the year provided for intensive education and training of staff nurses, and made maximum use of nursing assistants, including former military medical corpsmen.

Automated Laboratory Procedures

Research and development of computer-assisted automated laboratory testing procedures brought advancements in clinical chemistry, hematology, and infectious laboratory service.

Patient Load

The number of inpatients, 4,343, was an increase of over 300 above the previous year. Readmissions (for followup studies), 3,127, also increased at about the same rate over the number for 1969. In addition, the number of new outpatients for fiscal year 1970, increased by slightly more than 150 to 2,201.

The Clinical Center experienced a decrease of 42 permanent staff positions. However, total expenditures for salaries increased sharply to meet the cost of pay raises in July and December. The cost of all supplies (drugs, sterile supplies, linens, etc.) increased between 6 and 7 percent. Nevertheless, in April patient care facilities were established for the new National Eye Institute, and no essential Clinical Center program was discontinued.

Division of Biologics Standards

Hepatitis Research Program

The control of hepatitis remains an important challenge in medical virology. In the field of biologics, the disease constitutes a serious risk in the administration of blood and blood products. Transfused blood is known to cause more than 30,000 cases of overt hepatitis every year in the U.S. Of these patients up to 10 percent die. Because of this risk, and because eventually, as with other viral diseases, some forms of hepatitis will probably be controlled by a vaccine, the Division of Biologics Standards has for many years maintained an exploratory program of research on hepatitis.

In 1968, the DBS expanded hepatitis research in the Laboratory of Viral Immunology. Recent findings had linked hepatitis to a hitherto unknown factor found in the blood of an Australian aborigine. This factor, discovered in 1965, behaves like an antigen when the serum of a multiple-transfused patient is used as an antiserum. It was later shown that this antigen was intimately related to serum hepatitis. Thus demonstration of the presence of the hepatitis-associated antigen (HAA) is the first specific serologic means for detection of transfusion-associated hepatitis. During the year, the Laboratory staff made intensive efforts to evaluate the efficacy of the procedure and its practicality for blood donor screening. Plasma from patients with icteric viral hepatitis, which the DBS had stored since 1952 at -20°C , proved invaluable in these studies.

The Laboratory studies show that serum hepatitis can be transmitted by blood and blood products which contain HAA in amounts too low to be detected by current tests. However, they have also found that the clinical severity of serum hepatitis may depend somewhat on the dose of virus; therefore, elimination of carriers with the high antigen levels that are detectable by existing tests could decrease the incidence of more severe cases of serum hepatitis by 25 percent.

Research Contract

To broaden and extend the scope of its HAA and transfusion-associated hepatitis studies, the DBS initiated a \$206,300 contract with the New Jersey Department of Health. The 12-month study consists of collecting an additional pilot tube with every pint of blood collected in New Jersey, as well as some collected out-of-state by New Jersey licensed blood banks, to test for HAA. The study will

develop solid information on the rate of assessment of HAA-positive blood donors. It will also establish a bank of blood donor serum specimens to be used for evaluation of sensitivity and specificity of other techniques for the detection of HAA, as they are developed. Preliminary review indicates that the results will be extremely valuable in arriving at new standards for blood banking. The test material used is subject to licensure through the Division.

The DBS is also examining methods of propagation of hepatitis viruses in laboratory animals and cell culture systems.

Division of Computer Research and Technology

During the year, the Division effectively integrated computer sciences, engineering and mathematics to provide biomedical research, administration and educational uses.

The Computing Manifold

DCRT has distributed computing for NIH needs among several types and sizes of machines. This provides cost-effective solutions for particular requirements and unites many diverse elements in a unique computing manifold. The NIH Computer Center contains large interlinked general purpose computers. Other medium-sized computer systems, developed and installed by DCRT are shared by discrete user groups in several Institutes. Small computers and data preprocessors are dedicated to specific tasks in laboratories or clinics.

By connecting the smaller computers and 140 typewriter-like terminals, located close to scientists and administrators, to the central machines via standard telephone lines, DCRT provided rapid access to its multipurpose facilities so that a daily average of 2,100 jobs were run there during the year.

Uses For Management

The manifold's design allows the same facilities to create and query Institute administrative files, to automate the donor file of the Clinical Center Blood Bank and to serve many laboratories.

DCRT research was productive in many areas, including automatic indexing and retrieving of medical pathology reports, statistical analysis of human blood chemistry values, new descriptions of intra-molecular forces, and theoretical explanations of inter-molecular forces between large molecules and cells.

Technical developments included a prototype telephone accessible computer information system for practicing clinicians.



Division of Research Grants

The Division of Research Grants provided a communications link with the scientific community through participation of its staff in scientific meetings, seminars and workshops relating to the research interests of the National Institutes of Health.

Steps were taken to broaden the scope and improve administration of the Public Health Service policy on the use of human subjects in research and to have the policy extended to all components of the Department.

Efforts in the Division's statistics and analysis operations included conversion of the NIH Extramural Central Data System to a computer basis, improvement of techniques for automated publication of the *Research Grants Index*, and implementation of the Research Grants Index Storage and Retrieval System.

The predoctoral research fellowships program was discontinued in April 1970. Awards approved prior to that time will be supported.

The Training Opportunities Program (TOP) Committee was established in July 1969 to assist the Division Director in carrying out the NIH Affirmative Action Plan for equal employment opportunity.

A Guide to Grant and Award Programs of the National Institutes of Health (PHS Pub. No. 1067) was revised to include the programs of the Bureau of Health Professions Education and Manpower Training and the National Library of Medicine.



Division of Research Services

The change in the size and scope of DRS which occurred in June 1969 enabled the Division to concentrate wholly in the past fiscal year on programs concerned with direct support to NIH research, including biomedical engineering and instrumentation, environmental services, medical library services, animal production and care, and media production.

Animal Programs

Contracts were established for the purchase of selected strains of non-inbred rodents. If successful, use of this source will offset personnel reductions already experienced and facilitate maintenance of effective sanitation and workload levels.

A limited primate breeding program was initiated. Plans were made for a centralized primate holding facility and service on the Bethesda campus.

Biomedical Engineering

There was a distinct increase in the level of sophistication of technical collaboration and support provided to the NIH community. Noteworthy original contributions were made in providing materials, energy technology, mechanization, automation, physiological monitoring, patient care, and physiological systems analysis. Continual readjustment of priorities and curtailment of several promising lines of endeavor were necessary, however because of reductions in staff and funds.

A modest program for more economic utilization of scientific equipment was initiated and potential for substantial saving was demonstrated. Detailed plans were made and administrative approval obtained to begin operation on July 1, 1970, of a fiscally self-supporting scientific equipment rental program, based upon a pool of used instruments, for the entire NIH intramural community.

Environmental Services

A critical evaluation of biological hazards conducted in selected virus laboratories indicated that additional controls are needed in most laboratories. A registration procedure for tissue cultures and strains of virus used on the reservation was planned.

Planning of the water pollution control plant for the NIH Animal Center received priority attention. The staff provided data on water

usage, sewage flow and composition of the waste to be treated. A biological study was made of Broad Run to establish base line data prior to discharge of treated waste, which will occur when the plant becomes operational. The Environmental Services Branch (ESB) staff assisted the NIH Office of Engineering Services (OES) and the General Services Administration in negotiations with the county, state, and federal water pollution control authorities.

Staff members worked closely in the design and construction phases with the Engineering Design and Construction Engineering Branches, OES, to insure integrity of Building 36 laboratories. Specifications for horizontal, laminar flow clean benches were developed in cooperation with the Supply Management Branch, OES, and equipment manufacturers.

ESB personnel conducted a continuing training program for NIH employees. These encompassed operation and handling procedures for environmental control devices and practices. A three-day seminar on the Institutional Environment attracted 165 persons.

The Fogarty International Center

In fulfilling its mission as a focal point within the NIH and the Department for advanced study and discussion by outstanding scholars, the John E. Fogarty International Center for Advanced Study in the Health Sciences passed several significant milestones in FY 1970.

Scholars-in-Residence

Five Fogarty Scholars comprised the first group to participate in this program:

1. Professor Uriel Z. Littauer, Weizmann Institute of Science, Rehovot, Israel
2. Professor Ernest Singer, former Director of Microbiology, Queensland Institute of Medical Research, Brisbane, Australia
3. Professor P. C. C. Garnham, Emeritus Professor, University of London
4. Professor Torsten Teorell, Chairman, Department of Physiology and Biophysics, University of Uppsala, Sweden
5. Professor John Edsall, Biology Department, Harvard University

The scholars engaged in the conduct of seminars and training workshops, independent research, and individual writing projects. Typical of this activity was a seminar conducted by Professor Teorell on "Normal and Abnormal Heart Rhythmicity: Electrical and Mechanical Influences." Cosponsored by NHLI, the seminar stimulated discussion on the cause of irregular heartbeats, or arrhythmias.

Conference and Seminar Program

This was an active program during the year, with nine conferences held on varied subjects.

One of the most significant and timely was a conference on "Ethical Problems in Human Genetics—Early Diagnosis of Genetic Defects." More than 50 researchers and clinicians from seven countries discussed the use of amniocentesis to diagnose, prenatally, genetic defects such as Down's Syndrome (Mongolism). Amniocentesis is the procedure of puncturing the uterine wall in order to withdraw a small amount of amniotic fluid from the pregnant woman. Fetal cells floating free in the fluid are cultured and then examined for chromosomal abnormalities which may indicate a genetic defect in the fetus. A number of genetic disorders can now be

detected by this procedure. Scientists are hopeful that in the future these defects, once diagnosed, can be corrected prenatally.

Renovation of Stone House

Stone House, a stately mansion on the grounds of the National Institutes of Health, was renovated as a part of the Fogarty Center. The building provides library, study and living space for five Fogarty Scholars in addition to providing conference space.

Bureau of Health Professions Education and Manpower Training

ADMINISTRATIVE CHANGES

Re-emphasizing the importance of health manpower problems, Bureau Director Leonard D. Fenninger, M.D., was elevated to the newly created position of Associate Director for Health Manpower in the Office of the Director of the National Institutes of Health. Dr. Kenneth M. Endicott, until then Director of the National Cancer Institute, became Bureau Director. Dr. Robert M. Bucher, Dean of the Temple University School of Medicine, was appointed Deputy Director for Institutional Development, and Deputy Director Joseph A. Gallagher left to become Vice Chancellor for Health Planning, University of Texas System.

LEGISLATIVE DEVELOPMENTS

P.L. 91-208, which was approved March 12, 1970, extended three sections of the Public Health Service Act relating to public health training, and made them coterminous on June 30, 1973. These sections were section 309(c), authorizing formula grants to schools of public health; section 309(a), authorizing project grants to public or nonprofit institutions providing graduate or specialized training in public health; and section 306, authorizing grants for traineeships for graduate or specialized training in public health. These three authorities provide the legislative framework for strengthening and expanding training of public health personnel.

Bureau funding rose from \$417,833,000 in FY 1969 to \$433,235,000 in 1970; the number of permanent, full-time employees declined from 832 to 824.

Division of Allied Health Manpower

ALLIED HEALTH TRAINING

Grants totaling \$9,750,000 to 302 junior colleges and universities were awarded to improve 717 allied health educational programs with 22,837 students. Traineeships totaling \$1.55 million went to 408 trainees preparing to teach or qualify for other positions in the allied health professions. Curriculums were under development for new types of workers, such as orthopedic assistant, radiopharmacist, physical therapy assistant, hospital pharmacy technician, and electroencephalography technician.

PUBLIC HEALTH TRAINING

The number of schools of public health rose to 16 with the open-

ing of one at the University of Texas in Houston. Division grants for curriculum development totaled about \$9.5 million, with about half divided on a formula basis among the 16 schools. The remainder went to 124 special projects in graduate public health training, with about 8,000 students receiving benefits.

Traineeships totaling \$8 million were awarded to approximately 7,500 students enrolled in full-time academic training and short courses on public health aspects of nutrition, population planning, medical care administration, engineering, environmental health, and hospital administration.

NEW SPECIAL ACTIVITIES

The Division engaged in several activities related to preparing former military corpsmen for civilian employment in allied health occupations. A demonstration work-study program for Vietnam Era Veterans was initiated. Consultation was provided for the organization and implementation of Operation MEDIHC (Military Experience Directed Into Health Careers). Development of equivalency examinations in the medical laboratory field was begun.

Division of Dental Health

DENTAL ASSISTANTS

A five-year study completed during the year showed that a dentist can increase productivity up to 140 percent with a team of four assistants, and up to 80 percent with three assistants. Award of auxiliary utilization grants totaling \$3.65 million were made. About 29,000 graduates have now received clinical training. Schools with accredited programs in dental assisting increased from 151 to 173 in 1970.

DENTAL EDUCATION AND RESEARCH

The Division is cooperating with the National Dental Association to encourage black students to enter the dental profession, and is exploring computer-assisted instruction in dental and dental auxiliary education.

Eight research training grants totaling \$450,000 supported teacher education, education research, and public health. Ten fellows pursuing advanced degrees in dental research specialties received \$150,000. Five projects were awarded grants amounting to \$200,000 to establish a nationwide network of new continuing education systems.

Thirty-one grants totaling \$1,259,000 included support for task analysis in dental practice, and computer-aided instruction in dental diagnosis.

CARIES PREVENTION

This year marked the 25th anniversary of fluoridation in the United States. Almost 90 million people in some 4,834 communities now have access to fluoridated drinking water—the best known decay preventive. The Division continued its public education activities “in support of fluoridation.”

PREPAID DENTAL CARE

Prepaid dental care plans increased from 6.9 million coverage to 9.6 million in the past year. A new study was planned to document the cost, quality, and efficiency of dental care given by a group practice.

EPIDEMIOLOGY

Division epidemiologists analyzed birth certificates from 29 states and two cities in a search for factors associated with facial clefts.

Division of Educational and Research Facilities

HEALTH PROFESSIONS EDUCATIONAL FACILITIES

Matching construction funds totaling \$138,973,178 were awarded to 25 schools of medicine, dentistry, osteopathy, pharmacy, podiatry, optometry, public health, and veterinary medicine, enabling them to increase their capacity by 652 new first-year places. Of this amount, \$102,118,148 provided 322 new places in 11 schools of medicine and \$29,642,380 added 148 new places in seven schools of dentistry.

NURSE EDUCATION FACILITIES

Grants totaling \$11,414,032 to 11 schools of nursing provided 755 new first-year places. The total includes funds made available by reductions and withdrawals of previous awards.

HEALTH RESEARCH FACILITIES

This year, four grants totaling \$665,991 were awarded to build, remodel, and equip facilities for health-related research. These were made possible by reductions and withdrawals of previous awards.

Division of Health Manpower Educational Services

EDUCATIONAL IMPROVEMENT PROGRAM

The Division of Health Manpower Educational Services in FY 1970 made 261 institutional grants to schools of medicine, osteopathy, dentistry, pharmacy, veterinary medicine, optometry and podiatry in the total amount of \$46,500,000.

It made 137 special project grants to the same classes of schools in a total amount of \$54,299,601.

STUDENT ASSISTANT PROGRAM

The Division allocated \$12,281,000 in nursing student loans to 854 participating schools or programs with an estimated 17,544 student recipients, and \$10,727,139 in nursing scholarships to 677 schools or programs with an estimated 10,728 student recipients.

Allocation for health professions student loans totaled \$15,900,000 to 243 participating schools or programs for an estimated 14,055 student recipients. Health professions scholarships were allocated in the amount of \$15,540,648 to 268 schools or programs for an estimated 18,148 student recipients.

FOREIGN STUDENTS

Program and guidance services were provided to 557 new foreign students and 261 carry-over students by the foreign Students Education Program.

Division of Nursing

SPECIAL PROJECT GRANTS

Two grants enabled diploma schools in straitened circumstances to remain in operation long enough to graduate their last classes. Eight grants helped to establish new nursing programs, including one at an Indian community college in Arizona. Other grants are preparing adults with medical (such as ex-corpsmen) or public service (retiring police and firemen) experience for nursing practice.

MINORITY RECRUITMENT

Contracts to recruit members of minority groups for training as nurses increased from two to seven. Under one, a Harlem organization is recruiting Puerto Rican and black high school graduates from all five New York boroughs.

RESEARCH TRAINING

The first nurse-scientist graduate training grant to help an academic institution engage nurses in research training in clinical nursing went to a university which has 131 nurse scientist trainees enrolled for doctoral study in nine institutions. With the aid of special nurse fellowships, 161 other nurses are enrolled at 54 universities for research training.

The Division supported 51 research projects concerned with advancement of nursing research and the effect of nursing care on patients.

INCREASING NURSING RESPONSIBILITIES

With Division support, the graduate program at Yale University

conducted experimental training to equip nurses for decisive action in pediatric and medical clinics.

A Division consultant helped to design and conduct training for World Health Organization personnel for family-planning responsibilities in southeast Asia. The Division gave consultation in community planning for nursing to eight geographic entities, including Puerto Rico.

Division of Physician Manpower

PHYSICIAN EDUCATION

Of 85 medical and osteopathic schools receiving special project grants, 29 participated in the Physician Augmentation Program to increase first-year enrollments beyond commitments under other Federal programs.

A project to define criteria for selecting community hospitals for teaching medical students was initiated. Another will evaluate the semi-annual admissions system of the University of Tennessee, the only American school which graduates two classes a year.

CONTINUING EDUCATION

The Division awarded contracts to develop a computerized test bank of medical questions for identifying continuing clinical education needs of practicing physicians, to develop a program to utilize retired professors as resource personnel for educational programs in a small community hospital, and to identify criteria for journal article selection relevant to the clinical needs of practicing physicians.

PROFESSIONAL ACTIVITIES

Under a Division contract, a model is being developed to determine the physician needs of a defined area and to test methods of distributing physicians to meet those needs. Another study is examining various physician and supportive personnel mixes in a general practice setting.

PHYSICIAN RESOURCES

The Division provides a national clearinghouse on the supply, distribution, and availability of medical and osteopathic schools, students, graduates, and physicians. Its new publication, "How Medical Students Finance Their Education," identifies sources of student support. A project with the National Medical Association Foundation was begun to provide accurate statistical data about the location and characteristics of black physicians, for future recruitment and education of Negro students.

Division of Research Resources

SPECIAL RESEARCH RESOURCES

This program brings sophisticated equipment and new techniques, including computer centers, gas chromatography/mass spectrometry, and nuclear magnetic resonance spectrometry, to bear on medical problems. At one resource center, scientists are using a computer to build models of epidemics. By varying many disease factors, researchers can predict the spread of an epidemic and investigate the effectiveness of different public health measures in this age of world-wide jet travel.

GENERAL CLINICAL RESEARCH CENTERS

Each of the 80 general clinical research centers supported by the Division is a small research hospital within a main hospital, where doctors can study diseases, their causes, and treatment, thus contributing to understanding of health problems.

More than three-fourths of all the transplants done in the United States have been evaluated in clinical research centers. A team at one center last year transplanted 60 kidneys, five livers, and one heart, and now has more than 30 patients with transplanted kidneys who have survived more than six years. At another center, badly burned patients grew normal skin after receiving skin grafts produced in test tubes for the first time.

ANIMAL RESOURCES

The Division supports 68 specialized animal resources to probe human disease problems. One late development is a herd of miniature pigs that can develop artery disease and heart attacks similar to those in humans.

One of the seven primate research centers has developed a new treatment that offers hope of faster immunity to over 10 million hay fever sufferers. It has been successfully tested on rhesus monkeys and human patients sensitive to timothy grass pollen. The scientists are working on similar desensitization for ragweed, house dust, and other irritants.

GENERAL RESEARCH SUPPORT

This program provides flexible support for medical research and research training. One investigator so supported has set up a fetal intensive care unit in a hospital labor room. With sensitive monitoring of the physiological state of the fetus, and with careful observation of the mother's labor, the researcher is now able to identify subtle alterations in the physiological state of the fetus before they become a problem.

National Library of Medicine

The National Library of Medicine, in its commitment to improved health service through the creation of a modern biomedical library system, moved during the year toward improvement of services with a nationwide Regional Medical Library program, experiments to test feasibility of satellite communication, and reorganization of its National Medical Audiovisual Center.

A new Medical Literature and Analysis System (MEDLARS II) was further developed to provide more sophisticated information storage and retrieval capabilities as it replaces MEDLARS I. A computerized International Index of Medical Film Data was compiled.

The Library continued as technical support agent for the Pan American Health Organization Regional Library of Medicine in Sao Paulo, Brazil, and provided interlibrary loan, demand search, and other services to institutions within AID countries, under a specific agreement with the U.S. Agency for International Development. Personnel and budgetary limitations forced discontinuance, in September 1969, of service to all other foreign countries, but arrangements were made to provide such countries interlibrary and audiovisual loans for a fee to cover cost of handling and postage.

Library Operations

The one-millionth citation to MEDLARS was entered in August 1969. Approximately 210,000 articles were indexed for MEDLARS during the year. Some 14,300 MEDLARS demand searches were carried out for domestic users, over 25 percent more than the previous year. A new MEDLARS search center became operational in the Regional Medical Library at the New York Academy of Medicine, and others were established in Japan, Germany, and Switzerland; the center in France became fully operational.

In January 1970, the Library began publication of *Abridged Index Medicus*, a new monthly bibliography specifically designed for practicing physicians. Each issue contains citations from 100 English-language journals chosen for quality and particular value to doctors and to the libraries of small hospitals and clinics.

In May the first issue of a new recurring bibliography, *Parkinson's Disease & Related Disorders*, was produced by the NLM for the National Institute of Neurological Diseases and Stroke, replacing a Parkinson's Information Center alerting service publications at greatly reduced cost.

Two model exhibits, a "Tutorial Environment System," and a "Medical Education Jukebox," developed with NLM support, were displayed as examples of self-instructional devices. More than 100,000 interlibrary loan requests were received. Almost 600,000 pages of deteriorating and irreplaceable material were microfilmed to archival standards.

SPECIALIZED INFORMATION SERVICES

The Toxicology Information Program identified nationally some 4,000 individual toxicology professionals willing to provide direct assistance to the program on a voluntary basis. TIP, in cooperation with the National Referral Center, Library of Congress, produced *A Directory of Information Resources in the United States: General Toxicology*, listing approximately 700 potential information resources.

NATIONAL MEDICAL AUDIOVISUAL CENTER

NMAC completed a reorganization, shifting emphasis from motion picture and television production to expanded programs for the acquisition and distribution of audiovisual materials, related clearinghouse services, and educational research, consultation, training, and media development. Some 29 motion pictures and 41 television programs were completed, covering such areas as clinical pathology, concepts and controversies in modern medicine, physical diagnosis, and rehabilitation medicine. More than 7,000 subject-oriented searches from the computerized International Index were furnished during the year.

LISTER HILL NATIONAL CENTER FOR BIOMEDICAL COMMUNICATIONS

In cooperation with the NLM Library Operations staff, the Lister Hill Center initiated a new experimental service called the AIM-TWX System to provide rapid, responsive searching of the medical literature. Citations to articles published during the last five years in over 100 journals are being stored in a time-sharing computer. The journals include those in the new *Abridged Index Medicus*. This computer can be called from either TWX terminals or Teletype terminals connected to commercial telephone lines. This experiment is being conducted to assist in continuing medical education, and to provide information precisely when it is needed for health care.

The Center also initiated an experimental satellite communications project, using the NASA Applications Technology Satellites (ATS), to determine feasibility of satellite communications for medical consultation between remote areas and participating medical centers. A series of tests in April 1970 produced the successful transmission of live electrocardiograms, slow-scan television, and

color facsimile. The interrogation of a time-sharing computer through consoles linked via satellite also was accomplished.

EXTRAMURAL PROGRAMS

The Medical Library Assistance Act of 1965 enabled the Library this year to award \$6,157,000 for 465 grants and awards. A three year extension of the Medical Library Assistance Act enacted in March 1970 increases the previous authorization of \$21 million per year to \$27.5 million at the end of the third year. Other changes include a new policy for making resource grants, the addition of demonstration project authority, and a provision for planning grants for Regional Medical Libraries. Total coverage of the nation with RML services was completed during the year. Awards were made for the two remaining regions, South Central and Mid-Continental.

Under the Medical Library Assistance Act of 1965, new resource grants were awarded to 12 libraries, and continuing support to 385 libraries. More than 100 health information specialists received training support during the year. Five programs provided internships to 21 librarians for specialized training in information processing and medical librarianship.

NLM serves as the principal resource within the Department for the improvement of international exchange of published biomedical information in the special foreign currency program (Public Law 480). Projects in Israel, Poland, Yugoslavia, and India provided translations of biomedical monographs and journals, critical reviews, histories of medicine, conference proceedings, abstracting, indexing, audiovisual projects, and other international communication activities.



Appendices

NATIONAL INSTITUTES OF HEALTH APPROPRIATIONS, FISCAL YEAR 1970

(Dollars in

| | TOTAL | GRS | NIAID | NIAMD | NCI | NICHD | NIDR | NIEHS |
|---|-----------|--------|---------|---------|---------|--------|--------|--------|
| Total | 1,523,295 | 76,658 | 103,695 | 146,334 | 190,363 | 76,949 | 30,645 | 18,328 |
| Grants | 845,927 | 68,309 | 74,249 | 118,959 | 99,810 | 59,135 | 23,254 | 12,232 |
| Research | 646,267 | 67,831 | 61,196 | 94,505 | 83,495 | 45,627 | 16,147 | 8,451 |
| Fellowship | 53,191 | 126 | 4,081 | 7,000 | 4,374 | 3,616 | 1,612 | 164 |
| Training | 146,469 | 352 | 8,972 | 17,454 | 11,941 | 9,892 | 5,495 | 3,617 |
| Direct operations | 275,444 | 8,349 | 29,446 | 27,375 | 90,553 | 17,814 | 7,391 | 6,096 |
| Direct research | 89,871 | ----- | 15,272 | 16,191 | 17,245 | 6,021 | 4,922 | 5,316 |
| Biometry & epidemi- ology | 10,447 | ----- | ----- | 1,211 | 1,551 | 2,086 | 436 | ----- |
| Collaborative studies | 133,525 | 1,483 | 12,182 | 7,191 | 68,093 | 6,818 | 942 | ----- |
| Biologics standards | 8,225 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Training | 852 | ----- | 155 | ----- | ----- | 85 | ----- | ----- |
| Review & approval | 20,002 | 1,580 | 1,520 | 2,429 | 2,582 | 2,011 | 761 | 442 |
| Program direction | 6,140 | 640 | 317 | 353 | 1,082 | 793 | 330 | 338 |
| International research | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Computer res. & tech. | 4,646 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| International center | 1,737 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Health Prof. Educ. & Manpower Training | 373,249 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Health manpower | 234,470 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Dental Health | 11,722 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Construction grants | 126,100 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Loan funds | 957 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| National Library of Medicine | 19,682 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| OD/S. & E.* | 7,093 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Build. & Facil.* | 1,900 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |

NOTE: Column figures do not add due to rounding.

*New appropriations appearing in 1970

NATIONAL INSTITUTES OF HEALTH APPROPRIATIONS,
FISCAL YEAR 1970

thousands)

| NIGMS | NHLI | NINDS | DBS | HRF | FIC | BEMT | NLM | NEI* | OD* | B & F* |
|---------|---------|---------|-------|-------|---------|---------|--------|--------|-------|--------|
| 164,644 | 171,257 | 106,978 | 8,225 | 0 | 2,954 | 373,249 | 19,682 | 24,343 | 7,093 | 1,900 |
| 155,229 | 130,206 | 81,186 | ----- | ----- | 1,217 | ----- | ----- | 22,142 | ----- | ----- |
| 86,626 | 104,200 | 60,229 | ----- | ----- | 150 | ----- | ----- | 17,810 | ----- | ----- |
| 20,126 | 7,000 | 3,007 | ----- | ----- | 1,067 | ----- | ----- | 1,019 | ----- | ----- |
| 48,477 | 19,006 | 17,950 | ----- | ----- | ----- | ----- | ----- | 3,313 | ----- | ----- |
| 9,415 | 41,051 | 25,792 | 8,225 | ----- | 1,737 | ----- | ----- | 2,201 | ----- | ----- |
| ----- | 14,004 | 10,100 | ----- | ----- | ----- | ----- | ----- | 800 | ----- | ----- |
| ----- | 1,721 | 3,125 | ----- | ----- | ----- | ----- | ----- | 317 | ----- | ----- |
| 4,788 | 21,719 | 9,960 | ----- | ----- | ----- | ----- | ----- | 349 | ----- | ----- |
| ----- | ----- | ----- | 8,225 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| 336 | 204 | 72 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| 3,237 | 2,811 | 2,094 | ----- | ----- | ----- | ----- | ----- | 535 | ----- | ----- |
| 1,054 | 592 | 441 | ----- | ----- | ----- | ----- | ----- | 200 | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | 1,737 | ----- | ----- | ----- | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | 234,470 | ----- | ----- | ----- | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | 11,722 | ----- | ----- | ----- | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | 126,100 | ----- | ----- | ----- | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | 957 | ----- | ----- | ----- | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | ----- | ----- | 19,682 | ----- | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 7,093 | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 1,900 |

NIH GRANTS AND AWARDS BY INSTITUTE OR DIVISION AND PROGRAM, FISCAL YEAR 1970¹ (Dollars in millions)²

| Component | Total amount | | Research grants ³ | | Construction grants | | Training and education grants ⁴ | | Fellowships and traineeships | | Research career program awards | | Research contracts | | Medical library grants | |
|---|--------------|--------|------------------------------|--------|---------------------|--------|--|--------|------------------------------|--------|--------------------------------|--------|--------------------|---------|------------------------|--------|
| | | | Num-ber | Amount | Num-ber | Amount | Num-ber | Amount | Num-ber | Amount | Num-ber | Amount | Num-ber | Amount | Num-ber | Amount |
| Total----- | 5 | 11,339 | \$602.3 | 40 | \$151.1 | 5 | 2,155 | 127.5 | 5 | 2,920 | 1,087 | \$27.5 | 1,017 | \$105.3 | 405 | \$3.9 |
| Institute and Research Divisions----- | | | | | | | | | | | | | | | | |
| NIAMD----- | 753.1 | 10,526 | 479.9 | — | — | — | 2,155 | 127.5 | 2,920 | 1,086 | 27.5 | 861 | 96.5 | — | — | — |
| NIH----- | 68.5 | 1,265 | 49.1 | — | — | — | 16.4 | 8.4 | 128 | 1.1 | 110 | 2.5 | 132 | 8.3 | — | — |
| NIAMD----- | 102.7 | 2,255 | 78.0 | — | — | — | 267 | 16.4 | 271 | 1.3 | 3.5 | 3.5 | 37 | 3.4 | — | — |
| NIH----- | 128.1 | 1,132 | 76.4 | — | — | — | 151 | 19.8 | 189 | 1.6 | 83 | 0.5 | 285 | 43.4 | — | — |
| NIH----- | 8.9 | 884 | 16.4 | — | — | — | 131 | 3.3 | 88 | 0.4 | 20 | 0.5 | 1 | 8.6 | — | — |
| NIDHD----- | 60.7 | 884 | 46.1 | — | — | — | 131 | 3.3 | 88 | 0.4 | 20 | 0.5 | 1 | 8.6 | — | — |
| NIDHD----- | 20.7 | 203 | 13.1 | — | — | — | 103 | 3.2 | 92 | 0.7 | 38 | 0.3 | 130 | 7.1 | — | — |
| NIDHD----- | 11.7 | 7.4 | 7.4 | — | — | — | 103 | 3.2 | 92 | 0.7 | 38 | 0.3 | 130 | 7.1 | — | — |
| NIDHD----- | 13.9 | 1,184 | 68.9 | — | — | — | 562 | 44.3 | 83 | 0.2 | 4 | 0.1 | 7 | 0.6 | — | — |
| NIDHD----- | 130.2 | 1,687 | 86.5 | — | — | — | 368 | 16.5 | 140 | 3.8 | 383 | 8.4 | 9 | 1.5 | — | — |
| NINDS----- | 73.1 | 1,422 | 49.1 | — | — | — | 241 | 11.5 | 316 | 3.3 | 82 | 2.0 | 51 | 7.2 | — | — |
| FTC----- | 1.2 | — | — | — | — | — | — | — | 172 | 1.2 | — | — | 18 | 1.3 | — | — |
| DRS, DRG, DCRT----- | 0.2 | — | — | — | — | — | — | — | — | — | — | — | 8 | 0.2 | — | — |
| OD, CL, JOINT----- | 1.6 | — | — | — | — | — | — | — | — | — | — | — | 8 | 1.6 | — | — |
| Bu. Health Prof. Educ. & Man- Power Train----- | 764 | 121.1 | 40 | 151.0 | — | — | — | — | — | — | 1 | — | 116 | 5.2 | — | — |
| DAHM----- | 35 | 1.3 | 18 | 84.9 | — | — | — | — | — | — | 1 | — | 24 | 0.6 | — | — |
| DDH----- | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| DERF----- | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| DHMS----- | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| DN----- | 43 | 2.2 | 8 | 11.1 | — | — | — | — | — | — | — | — | 1 | 0.1 | — | — |
| DPM----- | 9 | 0.3 | 14 | 55.0 | — | — | — | — | — | — | — | — | 37 | 1.4 | — | — |
| DRR----- | 677 | 116.8 | — | — | — | — | — | — | — | — | — | — | 16 | 0.8 | — | — |
| OFFICE OF DIRECTOR----- | — | — | — | — | — | — | — | — | — | — | — | — | 11 | 0.9 | — | — |
| Nat. Lib. Med----- | 49 | 1.3 | — | — | — | — | — | — | — | — | — | — | 19 | 0.7 | — | — |
| | | | | | | | | | | | | | 40 | 3.6 | 405 | 3.9 |

¹ Preliminary data as of Nov. 10, 1970; excludes scientific evaluation grants.

² Dollars may not add to totals due to rounding.

³ Includes general grants-in-aid and research resource support grants.

⁴ Includes research training, educational improvement, allied health development, scholarship and opportunity, and traineeship grants.

⁵ Data are not yet available.

⁶ Less than \$50,000.

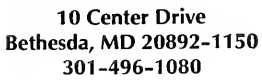
NATIONAL INSTITUTES OF HEALTH EMPLOYMENT BY COMPONENT, JUNE 30, 1970

| | (Full-time) 1969 | Comparison between FY 1969-1970 | (Full-time) 1970 |
|--|---------------------|--|---------------------|
| Total | 11,471 | -333 | 11,138 |
| Office of the Director | 1,925* | -37 | 1,888* |
| National Institute of Allergy and Infectious Diseases | 695 | -19 | 676 |
| National Institute of Arthritis and Metabolic Diseases | 615 | -27 | 588 |
| National Cancer Institute | 1,411 | -56 | 1,355 |
| National Institute of Child Health and Human Development | 400 | +15 | 415 |
| National Institute of Dental Research | 291 | -8 | 283 |
| National Institute of Environmental Health Sciences | 176 | +26 | 202 |
| National Eye Institute | 59 | +26 | 85 |
| National Institute of General Medical Sciences | 191 | -11 | 180 |
| National Heart and Lung Institute | 564 | -6 | 558 |
| National Institute of Neurological Diseases and Stroke | 652 | -64 | 588 |
| Clinical Center | 1,476 | -33 | 1,443 |
| Fogarty International Center | 46 | +2 | 48 |
| Division of Biologics Standards | 272 | -9 | 263 |
| Division of Computer Research and Technology | 302 | -18 | 284 |
| Division of Research Grants | 459 | -34 | 425 |
| Division of Research Services | 616 | -44 | 572 |
| Bureau of Health Professions, Education and Manpower Training | 832 | -8 | 824 |
| National Library of Medicine | 489 | -28 | 461 |

*Includes NIH Central Service functions.



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